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ORIGINAL ARTICLES.

I.—On Genera and Species of Spiral-Bearing Brachiopoda, from Specimens Developed by the Rev. Norman Glass: with Notes on the Results obtained by Mr. George Maw from Extensive Washings of the Wenlock and Ludlow Shales of Shropshire.

By Thomas Davidson, F.R.S., F.G.S., etc.

As some fifteen months must unavoidably elapse previous to the publication of the Silurian Supplement to my work on the British Fossil Brachiopoda, it has been considered desirable to anticipate a part of its contents, relating to the recent discoveries of the Rev. Norman Glass, of Manchester, as to the spirals and their connecting processes and attachments in the Brachiopoda of the Upper Silurian rocks.

The researches of Mr. Glass, referred to in this paper, but more fully to be detailed in the forthcoming Silurian Supplement, have been long and arduous, and the important and interesting results attained are only commensurate with the skill and perseverance which he has so abundantly shown. I feel greatly indebted to him for his prolonged and valuable assistance. The first difficulty besetting Mr. Glass in his operations was the finding of suitable specimens—hundreds of examples of a particular species being sometimes needed to produce the desired result. This difficulty has been overcome through the willing services of George Maw, Esq., F.L.S., F.G.S., of Benthall Hall, Shropshire, and my cordial thanks are due to him for the most generous manner in which he has had so many tons weight of the Wenlock Shale washed, and the old quarries of Benthall Edge carefully hand-picked, for specimens. Indeed, without the thousands of specimens thus procured, many of Mr. Glass's discoveries might never have seen the light. Other valuable results of the intelligent and indefatigable help which has been rendered to me by Mr. Maw will be shown in the stratigraphical sections and lists at the close of this paper. It should be added also that in sorting the specimens needed for the preparation of the stratigraphical lists and in many important suggestions, I have been greatly aided by the Rev. H. G. Day, of Brighton, and I desire gratefully to acknowledge his devoted assistance, rendered all the more trying and difficult from the minuteness of many of the shells.

It may be well to mention here that Professor James Hall and

Mr. Whitefield have also been engaged in developing the spirals and their connections in the Palæozoic Brachiopoda, but only in American specimens, and principally in siliceous shells, or in shells possessing a hard limestone matrix. Mr. Glass's operations, however, have been confined almost entirely to English specimens, and, as it will presently appear, to those English specimens only which were partly or wholly filled with spar. Having myself most carefully studied and drawn Mr. Glass's prepared specimens I am able to assert that they do not admit of doubt or misconception, and that they completely obviate the necessity of restoration—a process which must always be associated with some degree of uncertainty.

In my Carboniferous Supplement published by the Palæontographical Society at the commencement of 1880, I gave a brief account of Mr. Glass's discovery, accompanied by figures and descriptions of the spirals of no less than thirteen species of Carboniferous *Spirifera* and *Athyris*—all of them having been worked out by the new process. Since the preparations for the publication of the above supplement were completed Mr. Glass has been engaged in investigating not only the spirals, but also their connections in the shells of the Upper Silurian formation, and also in the Carboniferous shells of the genus *Athyris.* Mr. Glass had informed me previously that his process was unsuitable for developing the connecting lamellæ of the spirals. He has proved, however, by more recent researches, and even beyond his own expectations, that it is eminently adapted for that purpose.

The new process discovered by Mr. Glass simply applies to those shells which are partly or wholly filled with spar. In all the preparations that were figured in the Carboniferous Supplement the spirals were shown in their sparry matrix opaquely, but this method would have been very difficult in developing the spirals in the small Silurian Brachiopods, and would have been entirely useless in revealing their connecting lamellæ. Mr. Glass, indeed, except in one or two instances, was unable to show the connections of the spirals opaquely even in the larger specimens. However, that which could not be shown opaquely has been successfully developed by means of transparency. When the shells have been found wholly filled with spar, both valves have been removed, and the sparry matrix scraped away on either side until the spirals were clearly to be seen by holding the specimen up against the light. In order to show the connections of the spirals, not only the matrix surrounding the spirals, but also parts of the spirals themselves, have had to be scraped away in various directions. As I remarked in my Carboniferous Supplement, previously to the discovery of Mr. Glass's process our knowledge of the spirals of the Palæozoic Brachiopoda depended upon the rare chance of finding empty shells in which these appendages were naturally preserved, or upon the equally rare chance of finding specimens in which the shell and spirals were silicified so that the latter might be developed by the use of diluted acid. In addition to these means of obtaining knowledge in relation to the spirals, there was only the difficult and generally unsatisfactory method of making sections of the hard limestone matrix by which the shells were usually filled. Now, however, and by Mr. Glass's process, there is nothing in relation to the spirals or their connecting lamellæ in the Carboniferous and Silurian Brachiopoda that may not with time and patience be discovered. Mr. Glass has ascertained that many shells partly or wholly filled with spar are met with belonging to nearly every species, and whilst it is true that in a large proportion of these the spirals are either absent, fragmentary, or broken from the hinge-plate and displaced, yet specimens having all the required conditions do occasionally occur, and there is nothing to prevent a complete and satisfactory investigation.

As I have already said, there can be no mistake as to the certainty of the results attainable under this process. When the spirals are met with in the sparry matrix of the shell either in a fragmentary condition, or broken from the hinge-plate and displaced, there may be, and there frequently are, very confusing and doubtful appearances, but as soon as the spirals are found in a perfect condition, all that was before confusing and doubtful becomes clear and certain. This more especially applies to mature shells, for in younger specimens, even when otherwise perfect, it is sometimes difficult to get a clear conception of the spirals, arising from their not having assumed their normal shape and position in the shell. In the case just supposed, where under the new process clear and certain results have been obtained, the whole of the spirals either on the dorsal or ventral side, or the whole of the connecting process in its relations to the spirals, is seen, either opaquely or transparently *in situ* and at once, and not a bit at a time, as is the case where the spirals, etc., are endeavoured to be ascertained by the cutting of sections. This Mr. Glass thinks is a great disadvantage in the use of sections as compared with his process—a disadvantage greatly increased, as it seems to him, when the sections are not made through a sparry matrix which shows the lines of the spirals, etc., in relief, but through a hard earthy limestone, in which the lines are difficult to trace through their similarity of colour to the matrix. For the details of Mr. Glass's new process, in which hydrochloric acid is an indispensable agent, readers are referred to my Carboniferous Supplement, and also to the forthcoming Silurian Supplement, which will contain a more full account prepared by Mr. Glass at my request.

In 1866, when preparing my Silurian Monograph, I found it quite impossible to procure specimens of the spiral-bearing species of the British Silurian Brachiopoda showing more than a very incomplete indication of their internal processes, nor was it possible for me to develope them on account of the hard matrix which filled the shell. Since then, thanks to Mr. Glass's great skill, I can now furnish figures showing the complete spirals, the attachment to the hinge-plate, and in most cases the connecting processes of *Spirifera plicatella*, *Sp. crispa*, *Cyrtia exporrecta*, *Meristella tumida*, *M. didyma*, *Nucleospira pisum*, *Retzia Salteri*, *Atrypa reticularis*, *A. marginalis*, *A. Barrandi*, *Glassia obovata* and *G. elongata*, all worked out in their completed shape by Mr. Glass, and showing what can be achieved by his new process. All these perfect interiors will be fully described and illustrated in my Silurian Supplement.

In these investigations it has been clearly shown that the spiral-bearing Brachiopoda can be grouped according to the way in which the spirals are connected.

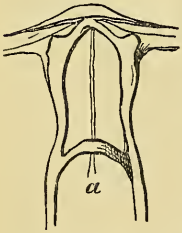
1. SPIRIFERIDÆ. *Spirifera, Spiriferina, Cyrtia, Cyrtina.*
2. ATHYRIDÆ, *Athyris, Meristella, Merista*, etc.
3. NUCLEOSPIRIDÆ, *Nucleospira, Retzia, Trematospira.*
4. ATRYPIDÆ, *Atrypa, Cœlospira, Zygospira, Glassia.*

I will now endeavour briefly to show the different characters presented in these groups from preparations developed by Mr. Glass, and principally from British Silurian specimens. These results are of the highest importance, for no good classification can be founded on external characters only, and the interior arrangements are by far the surest guides.

SPIRIFERIDÆ, King, 1850.

The spirals of *Spirifera, Spiriferina, Cyrtia* and *Cyrtina*, are all now well known. Mr. Glass worked out those belonging to *Spirifera plicatella, Sp. crispa* and *Cyrtia exporrecta*, in a very beautiful manner. We are not yet, however, acquainted with the shape of the lamella (which in all probability connected the two principal stems of the spirals) in any of the Spiriferidæ except *Spiriferina*, but I hope that Mr. Glass before long will be able to make this matter clear.

FIG. 1.



Spiriferina rostrata.

In 1851, I fully described and illustrated the spiral appendages of *Spiriferina*, their simple mode of attachment to the hinge-plate, as well as the position and shape of the semicircular lamella *a*, which connected the two spiral coils. I also showed that short spines projected from the spiral lamellæ on those parts that faced the front and lateral portions of the shell. This last-named feature has been well shown by Mr. Glass to occur also in *Athyris planosulcata* and *Atrypa marginalis.*

ATHYRIDÆ, Phillips, 1841.

This division of spiral-bearing Brachiopoda comprises several genera such as *Athyris, Merista*, and *Meristella.*

Genus ATHYRIS, McCoy = SPIRIGERA, D'Orb.

The internal characters of this important genus are now well known. The finding by Mr. Howse of a perfect empty interior of the dorsal valve of *A. pectinifera* enabled me to describe and illustrate, in a very complete manner, the shape of the spiral appendages, their mode of attachment to the hinge-plate, as well as the complicated system of lamellæ by which the two first stems of the spirals were connected. Again, in pl. xvii. of my Carboniferous

Monograph I figured the complete spiral appendages in *Athyris ambigua,* Sow. My figures had been completed from several specimens in the Museum of Practical Geology. Prof. Hall, in vol. iv. p. 289, of his Palæontology of New York, in 1867, described and illustrated the spiral appendages of *Athyris vittata,* their mode of attachment to the hinge-plate and the system of lamellæ connecting their two first coils. In the main his description and figure would agree with mine, but not quite so in details. In order that no misconceptions should exist upon the matter, the Rev. N. Glass, at my request, developed the spiral appendages and their connections in a number of specimens of *Athyris planosulcata* and *A. ambigua,* which had been liberally presented to him by Mr. John Tym, of Castleton. As will be seen from the figures here appended, drawn from Mr. Glass's worked specimens, his results would confirm the correctness of my previous illustrations.

FIG. 2.

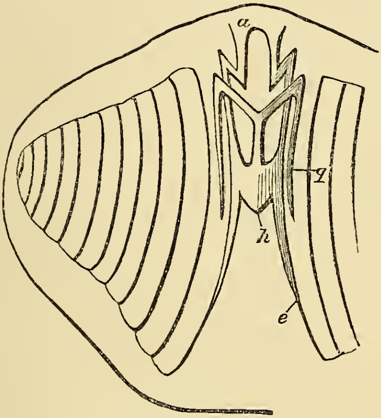
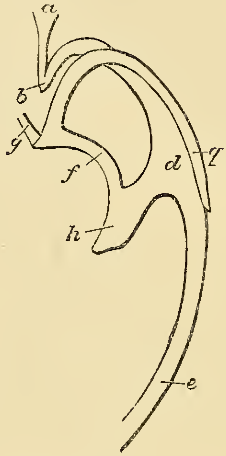


FIG. 3.



Athyris planosulcata, developed by the Rev. N. Glass.

In *Athyris planosulcata* Mr. Glass found that the first attachment of each spiral takes place at the hinge-plate *a.* From thence the two principal stems proceed for a short distance downwards, *b,* when they suddenly bend backwards forming a broad rounded curve facing the bottom of the dorsal valve *b, d, e.* At a little less than half their length at *d,* each principal stem widens and gives off a lamella *d, h,* which projects into the middle of the space intervening between the two spiral coils, and here the lamellæ are connected together and become expanded and roof-shaped. From the upper portion of the expanded and roof-shaped projection *h,* a curved lamella *f* extends upwards and bifurcating at its extremity gives off on either side a lamella *g,* which after forming a broad curve, and closely following the outer side of the first coil, ends near the place where the principal stem gives off its connecting process *q*. Indeed, Mr. Glass found in many specimens that this half coil lay much closer to the first than to the second coil of each spiral.

Now, as Mr. Glass has worked out very many specimens of *Athyris planosulcata,* and as they invariably show the same results and in the clearest possible manner, there can be no doubt as to our possession of every detail in connection with the spiral arrangements in the genus *Athyris,* especially as these preparations of Mr. Glass are fully corroborated by the specimens of *Athyris ambigua* which he also developed in a similar manner.

Genus MERISTELLA, Hall, 1859.

The working out of the spiral processes and their attachments in *Meristella tumida* does the Rev. Norman Glass the greatest possible credit. Not only has Mr. Glass been able to develop the spirals, but to take them entirely out of the shell, so that they can be examined in every direction. He has also completely excavated the inner side of one of the spiral cones, so that when held up between the eye and the light the various convolutions can be seen as a transparency. He likewise has been able to work out the attachment of the principal coils to the hinge-plate and their complicated system of connecting lamellæ. All these admirably prepared specimens will be fully illustrated in my forthcoming Supplement. As will be observed from the two diagrams here given, and drawn from Mr. Glass's specimens of *Meristella tumida,* the principal characters of the *Athyridæ* are maintained. The attachment to the hinge-plate at *a*, the short prolongation of the lamella *a, b,* its bending backwards

FIG. 4.

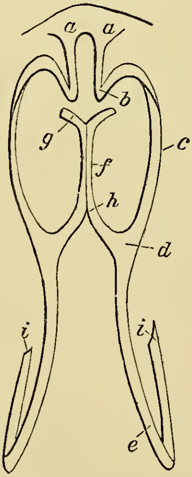
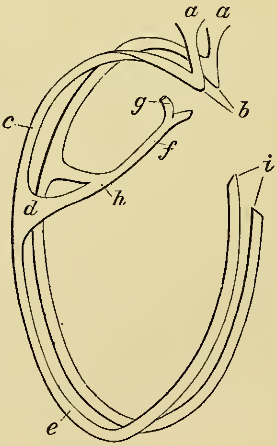


FIG. 5.



Meristella tumida, after Mr. Glass's preparations.

abruptly by a broad curve so as to form the first coil of the spiral, the giving forth at about half their length of an inwardly converging lamella *d*, *h*, by which both spirals are connected, the extension upwards of a narrow lamella *h*, *f*, *g*, and its bifurcation at *g*, remind us of *Athyris*, although differing in minor details, but at the point *g* the bifurcating process is short and small and does not, as in *Athyris*, give rise to a curved supplementary lamella. Now, as Mr. Glass has worked out a large number of *Athyris planosulcata* and of *Meristella tumida*, and as they have one and all constantly shown the same characters, we are justified in supposing they are persistent in each species of the same genus.

Prior, however, to Mr. Glass's researches, in vol. iv. of the Palæontology of New York, p. 298, Prof. J. Hall described and illustrated the spiral appendages, their attachment to the hinge-plate, and their connecting system of lamellæ, in *Meristella arcuata* (Hall) —a species so near in shape to our English *Meristella tumida* as to make one question whether it is not specifically the same. In Prof. Hall's figures the short forked process (*g* in our figures of *M. tumida*) extends and forms a complete circle, the branches uniting again at the point where they originated. Feeling some misgivings as to the correctness of Prof. Hall's illustration, in this particular, I wrote to Mr. Whitefield, who drew the figures, for some further explanations, and in his answer, dated the 6th of October, 1878, he says, "With regard to *Meristella* I can assure you there is no error in the figures published. Yesterday I took several of the specimens of *Meristella nasuta*, *M. lævis* and *M. arcuata*, and examined them; they all show the same features as given in the diagram in the text of vol. iv. Palæontology of New York. . . . They are not sections, but silicified specimens treated with acid, and the spire and loops are entirely revealed to the light. All the specimens described by Prof. Hall are now in the American Museum of Natural History." I have never seen the American specimens of *Meristella*, but I can assert that those worked out by Mr. Glass leave no room for misconception, and as they have all been most liberally presented to me by him, as well as all the other worked specimens of other species, they can be inspected by any one taking an interest in the subject. By comparing the diagrams given of *Meristella* and *Athyris*, the differences they present can be recognized better than they can be described by words.

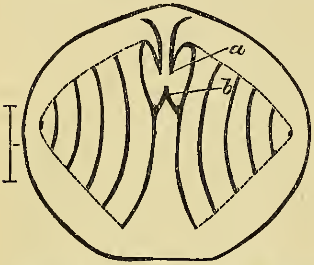
NUCLEOSPIRIDÆ.

In this group would be included *Nucleospira*, Hall, *Retzia*, King, and *Rhynchospira*, Hall. In the twelfth annual report of the Regents of the University of the State of New York, p. 24, 1859, Prof. James Hall gives a complete and illustrated description of his genus *Nucleospira*, exemplified by *Nucleospira ventricosa*, Hall.

At my request the Rev. Norman Glass has worked out in the fullest manner the characters of the spirals in *Nucleospira pisum*, their attachment to the hinge-plate, and the process connecting the spiral coils. His researches and prepared specimens agree in all important particulars with those obtained by Prof. Hall in *N. ventricosa*. *Nucleospira pisum* is one of the most abundant species in the Wenlock limestone and its underlying shales.

Each spiral is found to consist, as I had previously stated, of not more than six or seven convolutions, and the extremities of the spirals are directed towards the lateral portions of the shell. The two principal stems of the spiral coils are attached to the hinge-plate, and after extending a little way into the interior of the shell between the spirals, are suddenly bent backwards towards the hinge, and after forming a curve converge, to about two-thirds of their length, giving forth at that place short converging lamellæ, which unite in a sharp angular point, the extremity being directed towards the middle of the hinge-plate. Each of the two primary lamellæ diverge again as they proceed towards the front, and by a gentle curve form the first spiral coil. This arrangment is similar to that described by Prof. Hall in his genus *Meristina* (20th Annual Report of Regents of the University of the State of New York, revised edition, p. 186, 1868). In some specimens Mr. Glass has found the V-shaped lamellæ of which the inner branches are attached to the hinge-plate extending downwards so as nearly to meet the angular end of the connecting process, as is the case also in *N. ventricosa*. In no instance, however (and a large number of specimens have been operated upon), has Mr. Glass discovered any bifurcating process as in *Meristella* and *Athyris*.

Fig. 6.



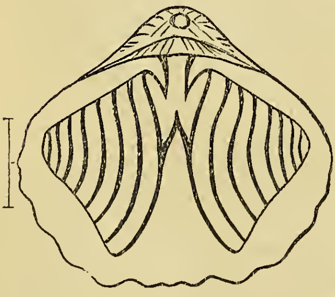
Nucleospira pisum seen from the surface facing the bottom of the dorsal valve, from preparations by the Rev. N. Glass.

Genus Retzia, King, 1850.

Nothing further relating to the type of the genus *Retzia*, viz. *Retzia Adrieni*, De Verneuil sp., is known beyond the fact that the shell was provided with spiral appendages.

Prof. Hall devotes seven pages of the Sixteenth Report of the Regents of the University of the State of New York, 1863, to the genus *Retzia* and to his genus *Trematospira*. *Retzia ? Salteri* and *R. Bouchardi* have been referred by Prof. King, myself and other palæontologists to the genus *Retzia*, and this is where I should leave them, at any rate until the internal appendages of *R. Adrieni* shall have been

Fig. 7.



Retzia Salteri, developed by the Rev. N. Glass.

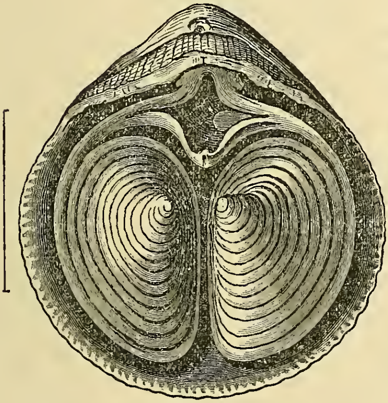
more fully determined. Nothing further than that *Retzia Salteri* was provided with spiral appendages had been discovered before Mr. Glass, at my request, worked out their mode of attachment to the hinge-plate and their connecting lamellæ. After many experiments Mr. Glass was able to show in the clearest possible manner that the spirals were attached to the hinge-plate and connected with each other in a similar manner to *Nucleospira pisum*. The only difference seems to lie in the spirals themselves, namely, that in *N. pisum* they are formed of five or six convolutions only, while about ten can be counted in each spiral in *Retzia Salteri*.

Family Atrypidæ, Dall, 1877.

Genus Atrypa, Dalman, 1828, type A. reticularis, Linné.

The interior characters of this genus have been completely described by Mr. K. P. Whitefield and Prof. J. Hall. Its spiral appendages, first attached to the hinge-plate, are placed side by side, with their extremities facing the middle of the bottom of the dorsal valve, as may be seen in the accompanying Figure. Mr. Glass has also developed the complete interiors of *Atrypa reticularis* from English specimens, and his worked specimens will be fully described and illustrated in my Silurian Supplement. The principal stems of the spiral coils at a short distance from their attachment to the hinge-plate are connected by a narrow band, the branches from either side converging downwards into a V-shape, and each branch being slightly turned up at its extremity. This band seems continuous in many specimens that have been operated upon, but, as stated by Mr. W. Gurley, in some individuals this loop or band would appear to be disunited, the inner ends opposing each other without being actually connected. I must also observe that the admirably prepared specimens by Mr. Glass show that the spiral appendages in the Dudley specimens of *A. reticularis* commence by forming very large coils, but that these soon become much smaller in diameter, forming two comparatively narrow cones, and that the extremities of these cones are closer together in some specimens than in others, and that sometimes one spiral cone seems a little longer than the other, one cone, for example, showing only fourteen convolutions, whilst its companion cone has as many as sixteen.

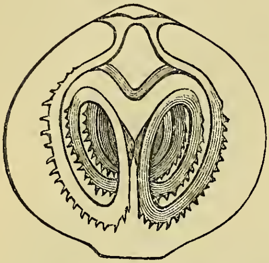
Fig. 8.



Atrypa reticularis, from an American specimen lent to me by Prof. J. Hall.

ATRYPA MARGINALIS, Dalman.

FIG. 9.



Atrypa marginalis, developed by Rev. N. Glass.

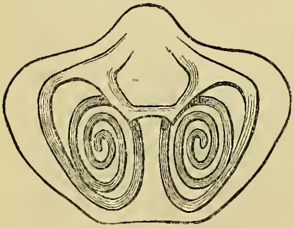
We are indebted to Mr. Glass for the knowledge we now possess with respect to the spiral appendages and connecting process in this remarkable species. The dorsal valve does not present the same degree of convexity or depth observable in that of *Atrypa reticularis*, so that the spirals are smaller, with a lesser degree of convexity. They do not show more than five convolutions, these being also more widely separated one from the other than is the case with Linnæus's species. The principal stems, as clearly seen in the two specimens developed by Mr. Glass, after being attached to the hinge-plate, are soon connected as in *A. reticularis* by a V-shaped lamella. The extremities of the spirals are close to each other and facing the middle portion of the bottom of the dorsal valve. As in *Atrypa Barrandi*, the two principal coils are not level, but slightly higher on their inner than on their outer sides.

Mr. Glass has also shown that the outer edge of each convolution, whether facing the lateral or frontal margins of the shell, gives off numerous small spiny projections in the same manner as in many examples of *Spirifer*, *Athyris*, *Waldheimia*, etc.

ATRYPA BARRANDI, Dav. sp.

During an excursion I made near Walsall in 1847, I picked up several specimens of the small species under description. Knowing nothing of its interior characters, I provisionally described it as a *Terebratula*, but subsequently I thought it might be referable to *Retzia*, on account of Dr. Lindstrom having found that the shell was possessed of spiral coils. In 1879 Prof. James Hall, at p. 162 of the Twenty-eighth Annual Report of the New York State Museum of Natural History of New York, states that the *Rh. Barrandi* seems to be very closely related if not identical with his *Cœlospira disparialis*; and in the same year Mr. Barrande, in the 5th volume of his magnificent and monumental work on the Silurian Fossils of Bohemia, describes *T. Barrandi* as a species of *Athyris*, but in his figure represents it with the spiral coils of an *Atrypa*.

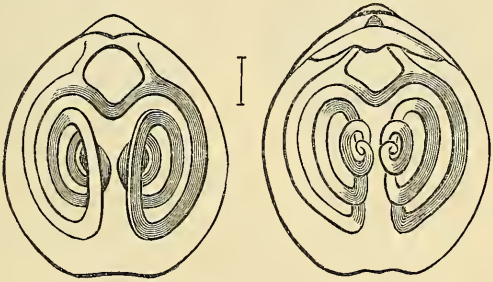
FIG. 10.



Cœlospira concava, after Hall.

It has however been left to Mr. Glass to entirely investigate and determine the interior characters of this species, so abundant and characteristic of the Wenlock Shales of Shropshire. The shell in size does not exceed some four lines in length, and the same in breadth, by three in depth, with nearly a flat or even slightly concave dorsal valve. Still, notwithstanding its small dimensions, after endless trouble Mr. Glass has succeeded in exposing in four specimens, and in the most complete manner possible, its spirals and their connecting process. These in the main agree pretty closely, although differing slightly in detail, with those of *Atrypa marginalis*, and Mr. Glass's specimens show that soon after the principal stems of the spirals leave their attachment to the hinge-plate, they give off a V-shaped lamella, by which they become connected, as in *Atrypa.*

FIG. 11. FIG. 12.



Atrypa Barrandi, Dav., developed by Rev. N. Glass.

The principal coils however are not quite level, as in *Atrypa.* The two inner sides of these coils being slightly higher than the two outer sides, and turned towards the margin of the shell. The ends of the spires curl over to meet each other, but the amount of convexity on the side facing the bottom of the dorsal valve is very slight, because there are but four or five convolutions, and this slightness of convexity is necessitated by the very small depth of the valve. I therefore believe that the spiral arrangement in *A. Barrandi* is only a modification of that of *Atrypa reticularis* and *A. marginalis,* and with which genus *A. Barrandi* should be classed.

Genus GLASSIA, genus nov.

Type *Glassia* (*Atrypa*) *obovata*, Sow., Sil. Syst., pl. viii. fig. 9, 1839.

Shell marginally circular, transversely or longitudinally oval, rounded or slightly indented in front. In the interior of the dorsal valve there are spiral coils for the support of the labial or brachial appendages. The principal lamellæ forming the first coils are at a short distance from the attachment of the hinge-plate connected together by a riband-shaped lamella or loop (as in *Atrypa*). This lamella, commencing on either side from the principal coils, converges downwards in the shape of the letter V (Fig. 14), and its two extremities are sometimes slightly turned upwards before uniting. The principal coils directly face the lateral margins. The ends of the spirals meet each other in the centre of the shell, and their close apposition sometimes serves to depress and thicken the end of the spirals and to conceal the final coil on either side. The spirals, which consist of from four to five coils, are compressed, and their compressed and oval shape, together with the distance which always occurs between the base of the spirals and the lateral margins, allows the necessary room for the first convolutions. The dorsal side of the spirals is flattened, whilst the ventral side is somewhat ventricose. The spirals are closer anteriorly, but broader on the posterior side, and the principal coils on the posterior side of the spirals are slightly notched or indented, the notch or indentation being in the direction of the end of the spiral. The posterior space between the spirals is not as wide as the anterior space.

Fig. 13.

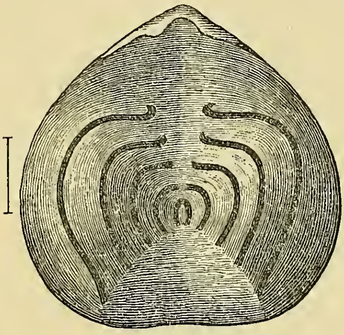
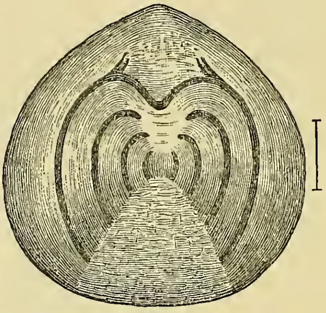


Fig. 14.



Glassia obovata, Davidson; developed by Rev. N. Glass.

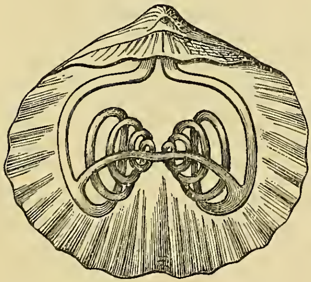
The discovery of this new genus, as well as of all its interior characters, is entirely due to the indefatigable exertions and persevering research of the Rev. Norman Glass, who, after many trials and endless trouble and patience, was enabled gradually to develop the spiral coils, their mode of attachment to the hinge-plate and their connecting process in the clearest and most unmistakable manner. I have therefore much pleasure in naming this genus after its discoverer.

The shells belonging to the genus *Glassia* are small, and both *Glassia obovata* and *Glassia elongata*, another species discovered by Mr. Glass, are common to the "Buildwas beds" (Lower Wenlock Shales), but do not occur in any great number.

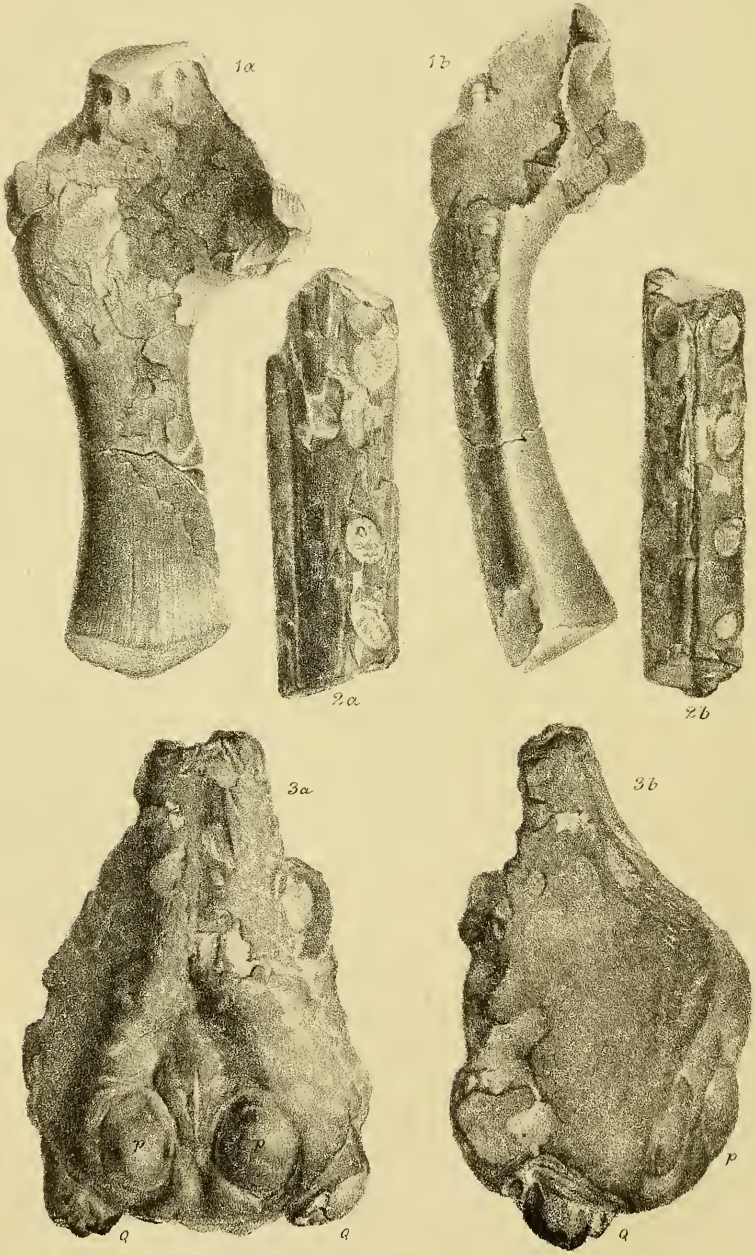
The genus *Glassia* unquestionably belongs to the family *Atrypidæ*, although it differs materially from both *Atrypa* and *Zygospira*.

Of *Zygospira*, Hall, we have not hitherto discovered any specimens in our English Silurian rocks. Prof. Hall states that its spires are nearly the same as in *Atrypa*, but differing in the presence of a strong loop or band which does not correspond in shape, position or character with the loop in *Atrypa*.

Fig. 15.



Zygospira modesta, after Hall.



G.M. Woodward del. et lith.
West, Newman & Co imp.

Remains of Ornithocheirus (*Seeley*)
Upper Greensand; *Cambridge*.

In *Glassia* the spirals are connected as in *Atrypa*, but it materially differs from this genus in the direction of its spirals.

For more ample details readers are referred to my forthcoming Silurian Monograph.

(*To be continued.*)

II.—ON EVIDENCE OF TWO ORNITHOSAURIANS REFERABLE TO THE GENUS *ORNITHOCHEIRUS*, FROM THE UPPER GREENSAND OF CAMBRIDGE, PRESERVED IN THE COLLECTION OF W. REED, Esq., F.G.S.

By Professor H. G. SEELEY, F.R.S., F.G.S., etc.

(PLATE I.)

THE fragments of jaws of Ornithosaurs from the Cambridge Greensand show a greater variety in size, form, and proportion than those from any other formation. The largest species were apparently the most singular in the shape of the snout, but after five-and-twenty years of collecting we still seem destined to know them only from fragments which, though extraordinary and suggestive, are tantalizing from their imperfect condition. It is impossible to tell whether the head was short or long, or what proportion it bore to the body, in the case of these isolated specimens, but some of them, like the jaw-fragment which I am about to describe, show a power of tooth and massiveness of bone which could only have pertained to one of the most destructive and probably one of the largest of these animals.

This specimen, the anterior extremity of a jaw, was submitted to me fourteen or fifteen years ago, by the courtesy of W. Reed, Esq., F.G.S., of York, and I then made the note on *Ornithocheirus Reedii* as well as the description of *Ornithocheirus xyphorhynchus*, a jaw of a slender and altogether different type, which were included in 1870 in my book on the Ornithosauria. The specimens have again been entrusted to me, for fuller description, but they still remain unique examples of the species of which they are types. Unfortunately, only the smallest portion of the palate is preserved in *Ornithocheirus Reedii*, as though the specimen had lain snout downward in the mud, and all the bone posterior to it had decayed. This fragment of the palate is not more than a millimètre and a half long in the median line where it is shortest, but it shows distinctly a deep narrow median groove, hardly more than a millimètre wide, which expands anteriorly and divides into two branches in a V shape. This condition of a median groove in the jaw-bone has hitherto been considered, and I believe correctly, to be distinctive of the lower jaw, and I therefore propose, notwithstanding the arrangement of teeth, which led me originally to regard it as a pre-maxillary bone, now to interpret it as the anterior portion of a dentary bone. I am led to this view also by the external form, which indicates a rapid compression of the sides towards the lower part of the jaw, and also by a remarkable oblique truncation of the under side of the mandible, which is somewhat paralleled in the *Ornithocheirus machærorhynchus* (Ornithosauria, pl. xii. fig. 1). The